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PINEAPPLE BRAN AS A FEED FOR LIVESTOCK

By

L. A. HENKE, Animal Husbandman

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SOURCE AND NATURE OF PINEAPPLE BRAN

Pineapple bran is a comparatively new feed made, so far as it is known, only in the Territory of Hawaii. Commercial production in Hawaii began only in 1923. The production of pineapple bran, practically all of which is consumed in the Territory was 1,726 tons in 1923, 3,563 tons in 1924, 7,355 tons in 1925, 6,966 tons in 1926, 7,043 tons in 1927, 7,052 tons in 1928, 7,345 tons in 1929, and 10,916 tons in 1930.

Pineapple bran was first made by the Hawaiian Pineapple Co., Ltd., under the direction of H. E. Savage. Although in the early, and also in much of the later, carefully controlled experimental work the feed value of the bran was determined by the University of Hawaii, the general observations and favorable opinions of most of the larger users of the new feed were undoubtedly the most powerful factors in promoting its sale and use.

Pineapple bran was originally called "dried pineapple waste," because the material from which it is made—principally the outer shell and sometimes also the core of the fruit—was the waste product of the pineapple canning industry. Although the material was known to be of value as a fertilizer, the cost and labor involved in transporting it to the fields did not warrant its use for the purpose, and often it was left to accumulate in adjoining gulches of the cannery.

The term "dried pineapple waste" was not attractive and implied a low-grade product of questionable value. Results of early experiments indicated that the feeding value of the product was sufficiently high to dignify it with a name. The product was called "pineapple pulp" for a time, and finally "pineapple bran."

The outer hulls of most of the cereals when removed and marketed as a separate product are usually known as bran. Since pineapple bran is made by grinding and drying the hull of the pineapple, the use of the term "bran" seems to be appropriate.

CHEMICAL COMPOSITION AND OTHER CHARACTERISTICS

Pineapple bran is high in sugar, low in protein, and fairly high in fiber. Four analyses of the material are given in the following tabulation:

	Fine bran (dust)[1] per cent	Coarse bran[1] per cent	Coarse bran[2] per cent	Composition of pineapple bran produced in 1930[3] per cent
Water	9.95	10.03	10.63	9.64
Protein	3.57	3,525	3.62	4.26
Fat (ether extract)	1.00	1.36	1.01	.88
Invert sugar	11.55	12.91	11.96	.....
Sucrose	5.33	7.14	8.70	.....
Sugar (total as invert)	.....	.....	.....	23.32
Starch (by difference)	.....	.....	42.15	.....
Starch (direct)	19.43	18.90	.....	21.78
Fiber	14.29	16.07	18.23	15.42
Ash	2.95	2.96	3.70	3.14
Water (insoluble solids)	.....	.....	.....	53.18
Acidity as citric acid	.....	.....	.....	2.20

The analyses agree fairly well except in the matter of starch. Professor Miller (*9, p. 10*)[4] in commenting on this, says "this not infrequently happens in analyses of plant materials where there are often considerable quantities of material which are not shown as 'crude fiber' but which are not starch."

The analyses of pineapple bran suggest its suitability for work animals and for fattening hogs and cattle without the addition of much protein. When the bran is fed to cows in milk and to brood sows and brood mares the ration should be supplemented with other feeds such as the various oil-cake meals, which are high in protein. Tankage is also an excellent protein supplement.

An excess of fiber in a feedstuff is not desirable. Pineapple bran is fairly high in fiber, containing about 16 per cent. A comparison of the more commonly used feeds shows that barley contains 4.6 per cent of fiber, corn 2 per cent, oats 10.9 per cent, dried beet pulp 18.9 per cent, wheat bran 9.5 per cent, and algaroba beans 26.6 per cent.

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[1] Determinations were made by Carey D. Miller at the University of Hawaii.
[2] Determinations were made by the Experiment Station of the Hawaiian Sugar Planters' Association.
[3] Determinations were made by the National Canners' Association.
[4] Numbers in italics refer to Literature Cited, page 19.

The digestibility of pineapple bran has not been determined by digestion trials. On the basis of the determined digestibility of similar feeds, it is estimated that pineapple bran contains 2.4 per cent of digestible protein, 48 per cent of digestible carbohydrates, and 0.6 per cent of digestible fat. Until more accurate information is available these figures may be of approximate value for use in computing balanced rations for various kinds of livestock.

Miller (*9, p. 10*) gives the following partial mineral analyses of coarse and fine bran:

"Ash analyses (on basis of original material):

	Coarse bran per cent	Fine bran per cent
Silica and sand	0.3970	0.517
Calcium	.1649	.1487
Phosphorus	.1462	.1158
Iron	.03197	.1206
(as per cent of ash)		
Calcium	5.572	5.041
Phosphorus	4.94	3.927
Iron	1.08	4.09 ."

Miller (*9, p. 10*) was of the opinion that the high iron content might have been due to the adherence to the outside of the fruit of a disproportionate amount of fine soil which found its way into the finer material. Hawaii soils are very high in iron. The fine bran is not being marketed as such now, but is being incorporated with the coarse bran. For hog feeding, the finer material is more desirable than the more coarsely ground pineapple bran.

The ash analyses show that pineapple bran is higher in calcium than are corn, wheat, or oats, and lower in phosphorus than are these grains.

Vitamin studies by Miller (*9, pp. 8 and 6*) show that pineapple bran is probably five to six times as good a source of vitamin A as the grains, and that the vitamin B content is slightly less than in whole wheat.

PINEAPPLE BRAN FOR WORK ANIMALS

Pineapple bran is essentially an energy-producing feed, and as such should be valuable for work animals. The university has only a few work horses and has not conducted definite feeding

experiments to determine the value of pineapple bran for work animals. However, the horses on the university farm have been satisfactorily fed a concentrate mixture consisting of equal parts of barley, wheat bran, and pineapple bran during the past 7 years at a saving of about 15 per cent in feed cost over the previously used concentrate mixture which consisted of equal parts of barley and wheat bran. This saving is based on the prevailing average market price paid for feeds, barley costing $50.65 per ton, wheat bran $43.92 per ton, and pineapple bran $26 per ton, delivered. These feeds were greatly reduced in price during the year, but the percentage of saving at this writing (March, 1931) remains about the same.

Pineapple bran is extensively used as a feed for plantation horses and mules.

The work animals of the Hawaiian Pineapple Co., Ltd., are fed daily a mixture of 50 per cent of barley, 40 per cent of pineapple bran, and 10 per cent of hay, supplemented with Panicum grass at night. This ration gives excellent results.

The average ration for the mules and horses of the California Packing Corporation is 7 pounds of pineapple bran, 7 pounds of barley, and 15 pounds of hay, or 5 pounds of hay and 20 pounds of Panicum grass. The manager comments as follows: "We find that the mules and horses are very fond of the above-mentioned mixture and that they keep in perfect condition. We have been feeding this bran for a number of years, and results of experiments show that there is an appreciable increase in the weight of the animals."

Libby, McNeill & Libby feed an average of 6.6 pounds each of pineapple bran and barley to their work animals, and state that "since using pineapple bran we have found that the working efficiency of our animals has not decreased and that our feed costs have been reduced considerably."

The McBryde Sugar Co., Ltd., of Eleele, Kauai, is feeding about equal parts of pineapple bran and barley to their mules and horses. Manager F. A. Alexander reports: "We have used a mixture of pineapple bran and rolled barley for a good many years. We find that the mules and horses continue to keep in good conditions even under heavy work."

The Ewa Plantation Company mixes 16 bags of barley with

5 bags of pineapple bran and feeds 6 to 18 pounds of the mixture daily to their mules and 5 to 9 pounds daily to the horses, the quantity depending on the work required.

Manager John M. Ross, of the Hakalau Plantation Co., reports using pineapple bran for over 1½ years with very gratifying results. "Since using pineapple bran," he says, "we have discontinued the use of hay entirely, and the animals in our stables look as well as, if not better than, when we fed them hay. Excepting the first two or three days when we made the change-over, the animals in our stables take to pineapple bran very readily."

Manager Ben Williams, of the ranch department of the Hawaiian Commercial and Sugar Company Plantation, on Maui, reports satisfactorily using pineapple bran since it was first produced at Kahului. He states that "with mules, horses, and cattle we have not observed any deleterious effect from the use of pineapple bran as a feed. After it is ground in a swing hammer machine (our invariable method of use), we find that it blends very nicely as an ingredient in our grain-molasses mixture, and does not, so far as we have been able to observe, affect the palatableness adversely."

The Koloa Sugar Company uses an average ration per day for work mules and horses of 6 pounds of rolled barley, 3 pounds of pineapple bran, 1¼ pounds of wheat bran, 4½ pounds of cane molasses, and from 40 to 60 pounds of sugar cane tops or of Panicum grass when sugar cane is not harvested. The molasses is poured over the roughage but is not mixed with the concentrates. The company also reports an appreciable wastage of the sugar cane tops. Manager John T. Moir comments as follows: "After 6 years of experience with pineapple bran, we feel quite safe in stating that it has a very distinct usefulness as a stock feed. It will remain useful as long as the price is such as to allow reduction of ration cost per pound. A point in its favor particularly worth noting is the fact that once accustomed to having it as part of their mixed feed, animals will prefer a ration containing it to one without pineapple bran. Several times we have found the work stock refuse to finish their rolled barley when pineapple bran was withheld from the mixture. This is without doubt due to the palatability and pleasant aroma of pineapple bran."

PINEAPPLE BRAN FOR DAIRY COWS

Experiments to determine the value of pineapple bran as a feed for dairy cows were begun at the university farm August 16, 1922, and continued for 12 weeks (*2, p. 20-27*). Six cows were divided into two equal groups, and at the end of each two-weeks' period the groups were reversed for feeding, the one receiving a 31 per cent of pineapple bran-concentrate mixture being placed on the standard university ration containing 31 per cent of corn, and the corn-mixture fed group being changed to the pineapple bran-concentrate mixture. The standard university mixture was made up of 75 pounds of cracked corn, 100 pounds of wheat bran, 50 pounds of coconut meal, 10 pounds of linseed oil-cake meal, and 5 pounds of salt. The pineapple bran mixture was made up of 75 pounds of pineapple bran, and the same proportion of each of the other ingredients excepting the cracked corn.

The six cows produced a total of 5,768.9 pounds of milk on the corn mixture, and 5,687 pounds on the pineapple-bran mixture, which was a difference of only about 1½ per cent in favor of the corn. At the then prevailing market price for the feed, the milk from the corn-mixture fed group was produced at a cost of 4.5 cents a quart, and that from the pineapple bran-mixture fed group at 4.21 cents a quart. This represented a saving of 6½ per cent in favor of the pineapple bran-concentrate mixture.

A comparison of the percentage of natural decrease in milk yield, due to the advancement of lactation of the cows while on pineapple bran with that during previous corresponding lactation periods of the same cows when on other kinds of feeds showed a somewhat greater decrease while on the pineapple-bran mixture. It was not known whether this decrease could be attributed to pineapple bran feeding or to unknown factors. It was therefore deemed desirable to start a long-period test with pineapple bran in the hope of obtaining further information on its value for dairy cows. The test (*4, p. 24; 5 p. 14; 6, p. 7; 8 p. 7*) was begun June 15, 1923, and concluded July 28, 1928. Four Holsteins and four Guernseys were included in the test, but for various reasons only three of the Guernseys and two of the Holsteins could be continued for a long enough period to get comparable results. During the period these five cows each completed five lactation periods, the first and second periods on a

basal ration, designated Feed X, the third and fourth periods on pineapple bran rations, designated Feed A and Feed B, and the fifth lactation period on the basal ration (Feed X) again. One cow was fed the pineapple bran ration for three consecutive years, receiving the basal ration only during the first and fifth years. Comparisons were made between the first and last lactation periods when the cows were on the basal rations and the intermediate lactation periods when the same cows were on the pineapple bran rations. Feeding of the ration was started three months before lactation actually began, but during the greater part of this preliminary period the cows were either dry or giving very little milk. This was done to accustom the cows to the new feed before lactation began, and also because precalving feed may affect milk yield after calving.

The basal ration (Feed X) was made up of 75 pounds of cracked corn, 100 pounds of wheat bran, 50 pounds of coconut oil-cake meal, and 10 pounds of linseed oil-cake meal. The one-third pineapple bran ration (Feed A) was made up of 60 pounds each of pineapple bran and rolled barley, and 20 pounds each of oats, wheat bran, and soybean oil-cake meal. The two-thirds pineapple bran ration (Feed B) was made up of 133 pounds of pineapple bran, 27 pounds of rolled barley, and 20 pounds each of linseed oil-cake meal and soybean oil-cake meal. Table 1 gives the weights of the cows during the test.

One to two per cent each of raw rock phosphate and salt was added to the concentrate mixtures as a safeguard against mineral deficiency. All the cows were fed in addition a small amount of beet pulp, usually two pounds per animal daily, throughout the test. The beet pulp was soaked for 12 hours before it was fed and was not mixed with the regular concentrate rations, but was fed separately. However, beet pulp was considered a concentrate and is so classified later.

The roughages fed varied somewhat from time to time both in quantity and in quality, depending on the yields of the university farm fields. Records of the kinds and quantities of roughage fed each cow were kept and their value was determined by assigning a suitable valuation for each kind. Green alfalfa valued at $10 a ton and green Sudan at $7 were the most commonly fed kinds. Other sorts used were Napier grass at $6 a ton, honohono (*Com-*

TABLE 1.—*Effect on weight of five cows of feeding a basal and one-third and two-third pineapple bran rations for the period June 15, 1923, to July 28, 1928.*

Breed and number of cow.	Date of birth.	Number of previous lactations.	Ration.	Weight at beginning of test on basal Feed X.	Weight at end of first test on basal Feed X.	Weight at end of test on pineapple bran Feed A or B.	Weight at end of second test on basal Feed X.
				Pounds	*Pounds*	*Pounds*	*Pounds*
Holstein: No. 9.	October 3, 1915	6	X and A	1,260	1,230	1,200	1,070
Guernsey: No. 18.	February 1, 1917	4	do.	1,140	1,070	1,155	890
Guernsey: No. 32.	February 16, 1921	0	do.	875	940	1,010	990
Guernsey: No. 20.	November 16, 1918	4	X and B	870	970	1,070	910
Holstein: No. 30.	July 23, 1920	1	do.	880	1,080	1,170	1,095

melina nudiflora) at $4, and Para grass at $5. The values here assigned to these roughages are based on their apparent values as a feed for cows in milk and the final tabulation shows value of roughage rather than pounds of roughage. Expressing roughage merely as pounds would be very misleading unless all details as to kinds of roughage were included, for alfalfa is worth far more than honohono. To give all the details here would make a very involved and confusing table, so roughage value only, which is the product of the quantity and of the quality of roughage is given. Table 2 summarizes the results.

Comments

All the cows maintained their weight or gained during the years they were fed on pineapple-bran mixtures.

The cows readily developed a fondness for pineapple bran. More difficulty was experienced in inducing them to return to the basal ration after they had been fed pineapple bran than in starting them on it.

Normal calves were born regularly to all the cows tested, and all the calves, except the twins of one cow, No. 9, lived.

The cows averaged a higher daily milk yield when on pineapple-bran mixtures, and at materially lower feed costs per pound of milk, than when on the basal ration. Three of the cows, Nos. 9, 18, and 20, were 12, 10, and 9 years of age, respectively, during the last year of the test when on the basal ration, and their lower milk yield in the last lactation may have been due to advancing age.

The milk averaged lower in butterfat content when the cows were fed on pineapple bran. This difference was not consistent year after year for cows Nos. 20 and 30, which had their lowest average yearly test while on the basal ration.

The average feed cost of 100 pounds of milk was $2.82 on the basal mixture in both groups as compared with only $2.25 for the same cows on the one-third pineapple-bran mixture, and $2.22 on the two-thirds pineapple-bran mixture. The saving in feed cost was about 20 per cent.

The results of the test indicated that pineapple bran when properly supplemented with high protein feeds, is good for dairy

TABLE 2.—*Comparison of production and feed costs of five cows on a basal and one-third and two-third pineapple bran rations.*

Cow.	Ration.	Days in milk	Average milk yield per lactation	Average daily yield of milk	Average content of butterfat	Average amount of concentrates fed daily
		Number	*Pounds*	*Pounds*	*Per Cent*	*Pounds*
Nos. 9, 18 and 32	Basal Feed X	300	5,627.5	18.76	4.19	10.6
	Feed A (one-third pineapple bran)	325	7,253.0	22.32	3.64	11.7
Nos. 20 and 30	Basal Feed X	280	5,404.7	19.30	3.90	11.4
	Feed B (two-thirds pineapple bran)	349	7,190.9	20.60	3.80	10.7

Cow.	Ration.	Proportion of milk per pound of concentrate	Concentrate feed cost per 100 pounds of milk	Roughage cost per day	Total feed cost per 100 pounds of milk	Total feed cost per pound of butterfat
		Pounds				
Nos. 9, 18, and 32	Basal Feed X	1.77	$1.37	$0.272	$2.82	$0.693
	Feed A (one-third pineapple bran)	1.91	1.15	.246	2.25	.650
Nos. 20 and 30	Basal Feed X	1.69	1.43	.268	2.82	.766
	Feed B (two-thirds pineapple bran)	1.92	1.05	.240	2.22	.614

cows, and was economically fed at the prices prevailing during the period of the test, 1923 to 1928.

Pineapple Bran As a Substitute for Beet Pulp

Pineapple bran has largely replaced beet pulp and like it is soaked for 12 hours before being fed in some of the dairies in Honolulu along the slopes of Diamond Head. In four of the dairies averaging 85 cows each with an average yield of 19 pounds of milk per cow per day, the average cow is fed 11 pounds of pineapple bran daily along with about 4 pounds of soybean oil-cake meal, and barley, wheat bran, or other feeds to total about 20 pounds. In addition the cows are fed limited quantities of green roughages consisting largely of Panicum grass, Hilo grass, and honohono. Roughages probably do not exceed 20 pounds per cow per day. This ration just about satisfies the Morrison feeding standard in total nutrient requirements, but provides about 50 per cent more protein than it suggests.

Pineapple bran is said to be soaked before feeding, rather than mixed with other concentrates and fed dry, because it is easier to feed and because soaking lessens the tendency of the acid to cut channels in the cement mangers in draining. However, at the university where pineapple bran was fed dry, the cement mangers were found to have been only slightly injured after 5 years of use in pineapple-bran feeding.

Pineapple Bran for Cows on Pasture

At a 50-cow dairy on windward Oahu, near Kaneohe, the owner feeds pineapple bran dry, mixing it with some other concentrates. His average cow produces 27 pounds of milk daily and is fed an average daily ration of 13 pounds of pineapple bran, 5 pounds of soybean oil-cake meal, and 5 pounds of a 20 per cent protein dairy feed. These cattle have pasture for roughage but eat only a rather limited amount of the grass.

On the basis of the Morrison feeding standards, this ration also supplies an excess of about 50 per cent protein. The dairymen in commenting on this fact state that a reduction in the amount of soybean meal or other protein source fed causes a material decrease in milk flow.

PINEAPPLE BRAN FOR SWINE

Test No. 1.—The first tests with pineapple bran at the university farm were designed to determine its value as a hog feed and were started February 23, 1922 (*1, pp. 33-40*). Pineapple bran was one of five feeds in self-feeders made available to seven 3-months-old Berkshire pigs averaging 45 pounds at the beginning of the test. The test was continued for 12 weeks during which the lot averaged 0.98 pound of gain per head per day, and consumed a total of 2,043 pounds of concentrates at a feed cost of 9 cents per pound of gain. The feeds fed free choice from self-feeders were 360 pounds of rolled barley or 18 per cent, 835 pounds of cracked corn or 41 per cent, 390 pounds of wheat middlings or 19 per cent, 186 pounds of pineapple bran or 9 per cent, and 272 pounds of tankage or 13 per cent.

Test No. 2.—Simultaneously with Test No. 1, eight 3-months-old Berkshire pigs having an average weight of 45 pounds each were given free access to self-feeders for 6 weeks during which they consumed 865 pounds of feed in the following proportions: 48 pounds of pineapple bran or 5 per cent, 262 pounds of rolled barley or 30 per cent, 84 pounds of cassava meal or 10 per cent, 126 pounds of cassava-molasses meal or 15 per cent, 252 pounds of wheat middlings or 29 per cent, and 93 pounds of tankage or 11 per cent.

During the period the lot made an average daily gain per head of 0.69 pound at a feed cost of 9.2 cents per pound.

Test No. 3.—Obviously, the pigs were not eating much of the pineapple bran under the free choice system, so they were fed all they would eat of a mixture consisting of 30 pounds of pineapple bran, 30 pounds of wheat middlings, 20 pounds of rolled barley, 10 pounds of coconut meal, and 10 pounds of tankage. The pigs, now 18 weeks old and averaging 74 pounds in weight, were kept on this mixture for 3 weeks during which they averaged 0.9 pound daily gain at a feed cost of 8.9 cents per pound.

Test No. 4.—For the next 3 weeks the 8 pigs, now averaging 93 pounds in weight, were fed a mixture containing 50 pounds of pineaple bran, 30 pounds wheat middlings, and 10 pounds each of coconut meal and tankage and on this ration they made an aver-

age daily gain of 1.08 pounds per head at a feed cost of 7 cents per pound.

Test No. 5.—The results of the preliminary tests indicated that pineapple bran should be mixed with other feeds if the pigs are expected to consume it in desirable amounts. The mixture described in Test No. 4 was supplemented with minerals and with ½ to 1 pound of green alfalfa per pig daily and fed in repeated tests from self-feeders.

Control Groups

In most instances a control lot of pigs was placed on other feeds.

Test No. 1.—The pigs in this group were fed 93 pounds of barley and 7 pounds of tankage.

Test No. 2.—The pigs in this group were fed 90 pounds of barley and 10 pounds of tankage.

Test No. 3.—The pigs in this group were fed 50 pounds of pineapple bran, 30 pounds of rice bran, 10 pounds of coconut meal, and 10 pounds of tankage.

Test No. 4.—The pigs in this group were fed 60 pounds of pineapple bran, 20 pounds of wheat middlings, and 10 pounds each of coconut meal and tankage.

Test No. 5.—The pigs in this group were fed the regular 50 pound pineapple mixture except that no supplementary green alfalfa was given.

The results (*2, p. 27; 3, p. 18; 4, p. 27; 5, p. 17; 6, p. 13; 7, p. 12; 8, p. 30*) are given in Table 3.

Comments

The results of the ten tests summarized in Table 3 indicate that pineapple bran can be used advantageously as a feed for fattening swine. On the 50 per cent pineapple bran-mixture described, the average pig weighing 67 pounds at the beginning of the test made an average daily gain of 0.97 pound during a period averaging 81 days at a feed cost of $0.101 per pound of gain. About 4.68 pounds of concentrates supplemented with one-half to one pound of green alfalfa were required per pound of gain. The data for the individual groups in the tests vary considerably from the

TABLE 3.—*Comparison of gains in weight and cost per pound of gain of pigs on pineapple bran and on control mixtures*

Number of pigs per group.	Duration of test.	Average weight of pigs at beginning of test.	Group of Pineapple-bran mixture			Control Group.			
			Average daily gain	Proportion of concentrates per pound of gain.	Feed cost per pound of gain	Test number.	Average daily gain.	Proportion of concentrates per pound of gain.	Feed cost per pound of gain.
	Days.	*Pounds.*	*Pounds.*	*Pounds.*			*Pounds.*	*Pounds.*	
8	21	93	1.08	3.70	$0.070	....	.....	.....	.....
7	38	71	.98	4.53	.093	1	1.06	5.19	$0.106
5	85	80	1.08	4.24	.086	2	1.34	4.02	.110
5	85	80	.....	.....	.....	3	.91	4.98	.092
4	84	53	1.04	3.43	.079	....	.....	.....	.....
4	84	60	1.08	4.59	.104	4	.72	4.96	.105
4	126	47	.98	4.19	.097	3	.66	4.65	.099
4	99	73	1.02	5.45	.118	....	.....	.....	.....
6	126	56	.82	5.47[1]	.115	2	1.11	4.25[1]	.104
5	63	45	.71	5.39[1]	.121	....	.....	.....	.....
8	84	94	.92	5.80[1]	.127	5	.82	6.40[1]	.136
Ave.	81	67	.97	4.68	.101				

[1] Three pounds of tankage was replaced with 3 pounds of linseed oil-cake meal.

average, because of the age of the pigs in the different groups, the condition of the pigs, and the cost of feed.

The pigs fed on barley and tankage made better gains per day and required somewhat less feed per pound of gain, but the gains in most cases were made at a higher feed cost.

The one attempt made to increase pineapple bran to 60 per cent of the concentrate mixture (Test No. 4 of the control group) resulted in lower gains, with increased feed required per pound of gain and was not economcal.

In two of the three tests where a barley and tankage mixture was used for the control group, the 50 per cent pineapple-bran resulted in more economical gains, the average feed costs on these three tests being 9.8 cents on the pineapple bran, and 10.7 cents on the barley-tankage mixture. This will vary, however, depending on the prices of the different feeds. Probably the best way to determine the relative economy of these two mixtures is to calculate the feed cost of a pound of gain based on the pounds of concentrates required to make a pound of gain. In these three tests it was 4.75 pounds for the pineapple-bran mixture, and 4.49 pounds for the barley-tankage ration.

At market prices prevailing at this writing (March, 1931), pineapple bran costs $18 per ton, middlings $35 per ton, coconut meal $41 per ton, tankage $90 per ton, barley $36 per ton, and green alfalfa $10 per ton. Based on feed requirements in the three tests reported, and assuming one pound of green alfalfa fed each pig daily, the price per pound of gain with the pineapple-bran mixture would be found to be 8.2 cents and 9.8 cents with the 90 per cent of barley and the 10 per cent tankage mixture. Pineapple bran as it now appears on the market without being ground is rather too coarse for best results in hog feeding. Swine seem to eat pineapple bran in the largest amounts when it is rather finely ground.

PINEAPPLE BRAN FOR POULTRY AND FOR BEEF CATTLE

A test, conducted by J. Otis Dale [5] at the university to determine the value of pineapple bran as a poultry feed, did not give con-

[5] Unpublished data of the University of Hawaii.

clusive results, but in all instances the production was lower when pineapple bran was included in the ration for laying hens in amounts ranging from 12½ to 37½ per cent. The results are tabulated below.

Feed.	Percentage of eggs produced.	Feed cost per dozen eggs.
Standard	100.00	$0.24
Pineapple bran (12½ per cent)	86.40	.25
Pineapple bran (25 per cent)	91.90	.21
Pineapple bran (37½ per cent)	77.2	.25

These results are rather illogical, for whereas the pen receiving 37½ per cent of pineapple bran made the lowest egg yield, the pen receiving 25 per cent of pineapple bran made a higher yield than the pen receiving only 12½ per cent. Pineapple bran for poultry should be finely ground.

Beef cattle are seldom grain fed before they are marketed in Hawaii, and the writer does not know of the making of any experiments to determine the value of pineapple bran for fattening them. However, because of the high sugar content of the material and its palatability, it should prove to be a valuable feed for beef cattle.

SUMMARY

Pineapple bran is made from the outer shell and sometimes also from the core of the pineapple fruit.

These are by-products of the pineapple canning industry and when properly dried and ground make a valuable feed for livestock chiefly because of the high sugar content.

The value of pineapple bran as a feed for work animals has been amply demonstrated on the pineapple plantations of Hawaii.

Pineapple bran is low in protein and needs to be supplemented with high-protein feeds when fed to dairy cows. It then makes a good and economical feed.

As a feed for fattening swine, pineapple bran is not equal to corn or to barley. However, at feed prices prevailing during the past 7 years in the Territory of Hawaii gains are produced at materially lower costs per pound when pineapple bran constitutes about 50 per cent of the ration for fattening swine.

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